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Implicit and Explicit Attitudes Predict Smoking Cessation: Moderating Effects of Experienced Failure to Control Smoking and Plans to Quit

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Abstract

The current study tested implicit and explicit attitudes as prospective predictors of smoking cessation in a Midwestern community sample of smokers. Results showed that the effects of attitudes significantly varied with levels of experienced failure to control smoking and plans to quit. Explicit attitudes significantly predicted later cessation among those with low (but not high or average) levels of experienced failure to control smoking. Conversely, however, implicit attitudes significantly predicted later cessation among those with high levels of experienced failure to control smoking, but only if they had a plan to quit. Because smoking cessation involves both controlled and automatic processes, interventions may need to consider attitude change interventions that focus on both implicit and explicit attitudes.

Keywords

implicit and explicit attitudes; smoking cessation

Despite declines in recent years, more than 20% of adults in the U.S. continue to smoke, and cigarette smoking remains the single largest preventable cause of death in the United States (Centers for Disease Control and Prevention, 2009). Given the impact of cigarette smoking, considerable public health effort has been directed at tobacco control, including both prevention and cessation programs. Moreover, these tobacco control programs often include messages designed to change attitudes toward smoking in order to deter adolescents from

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beginning to smoke or to influence adults to attempt smoking cessation (National Cancer Institute, 2008).

Attitudes have long been considered to be central in predicting behavior in general (Allport, 1954; Ajzen & Fishbein, 1977; Fazio & Zanna, 1981) and health-related behaviors in particular (Godin & Kok, 1996). However, explicit measures in which participants are directly asked to provide their attitudes are not always good predictors of behavior (Wicker, 1969), including cigarette smoking (DeLeeuw et al., 2008; Godin et al., 1992). Given conflicting findings, researchers have identified conditions that influence the strength of the relation between explicit measures of attitudes and behavior. For example, Ajzen and Fishbein (1977) focused on the degree of specificity of the attitude measure and its similarity to the subsequent behavior, and Fazio and Zanna (1981) identified the importance of direct experience in determining the ability of explicit attitudes to predict behavior. Most important for the case of cigarette smoking, when a target behavior involves social desirability concerns, explicit self-reports of attitudes do not predict the behavior well (Crowne & Marlowe, 1960; Nosek, 2005).

In recent years, implicit measures of attitudes have been developed that are not as susceptible to social desirability concerns. These measures reflect more automatic evaluative associations with the target object that are not under conscious control and thus are less distorted in a socially desirable direction. For example, more racial or gender prejudice is revealed on implicit measures than on explicit measures (Dovidio et al., 1997; Greenwald & Banaji, 1995). For socially stigmatized behaviors, implicit measures have predicted behavior better than have paper and pencil measures (Dovidio, Kawakami, & Gaertner, 2002; Fazio & Olson, 2003; Perdue & Gurtman, 1990).

For addictive behaviors, including cigarette smoking, implicit measures of attitudes may be useful not only because they are less affected by social desirability, but also because they reflect the operation of automatic processes that are important determinants of substance use. Dual process models of substance use (e.g., Wiers & Stacy, 2006) suggest that addictive behaviors are determined by a combination of controlled processes (which are reflective and under conscious control) and automatic processes (which are more impulsive and based on automatically-activated associations that may be outside of conscious control). Explicit measures of attitudes, in which individuals directly report their evaluations of a target behavior, rely more on conscious, reflective, controlled processes. In contrast, implicit measures of attitudes that rely more on automatic evaluative associations are more likely to tap into automatic processes.

In fact, measures of implicit attitudes are related to alcohol use and binge drinking (e.g., Thush & Wiers, 2007) and marijuana use (e.g., Stacy, 1997). Indeed, a recent meta-analysis (Rooke et al., 2008) concluded that implicit cognition was a reliable correlate of substance use, with an average effect size of moderate magnitude. Given the theoretical importance of implicit attitudes as well as their relation to substance use, some researchers have suggested that interventions to change these automatic evaluative associations may be useful in substance use interventions (e.g., Wiers & Stacy, 2006). However, studies linking implicit attitudes to actual substance use behavior have been either cross-sectional or did not examine change in substance use behavior (Grenard et al., 2008; Thush & Wiers, 2007; Thush et al., 2008) or examined behavior only after two weeks (Houben et al., 2010). Thus, there is a need for prospective studies to test the relation between implicit attitudes and future changes in substance use.

In terms of cigarette smoking, implicit attitudes have been related to motivation to smoke (Payne et al., 2007; Waters et al., 2007), craving (Mogg et al., 2003; Waters et al., 2007),

and tobacco dependence (Waters et al., 2007). However, only two previous studies have tested whether implicit attitudes actually prospectively predict smoking behavior. Among a sample of adolescent nonsmokers, implicit attitudes toward smoking prospectively predicted later smoking onset above and beyond explicit measures and parental smoking (Sherman et al., 2009). Kahler et al. (2007) found that initial negative associations to the social consequences of smoking among adult smokers receiving a cessation intervention predicted seven-day abstinence eight weeks after the quit date, above and beyond explicit measures. Kahler et al.'s findings are an important demonstration that implicit attitudes can prospectively predict smoking cessation. However, because most smokers do not receive treatment, these findings may not generalize to community samples, or to long-term cessation outcomes. Therefore, the first goal of the current study was to extend this work on smoking cessation to a community sample of smokers and test the ability of implicit attitudes to predict cessation after a long time interval (18-months) and for a longer duration of nonsmoking (past month).

More important, however, in testing the ability of attitudes to predict smoking cessation, it is overly simplistic to presume that only implicit attitudes will be successful. Rather, as suggested by dual process models (e.g., Wiers & Stacy, 2006), it may be necessary to consider both implicit and explicit attitudes as differentially important under different circumstances. More specifically, Friese, Hofmann, and Schmitt (2009) propose that, under conditions when the opportunity for control of behavior or the motivation to control behavior or the reliance on controlled processes is high (either because of dispositional individual differences, situational constraints, or aspects of the target behavior), then explicit, controlled processes should be more predictive of subsequent behavior. Conversely, when controlled processes are weakened, the effects of automatic associations and implicit attitudes should be stronger.

Laboratory studies have provided some support for this hypothesis. For example, experimentally lowering environmental control (e.g., by administering alcohol, Hofmann & Friese, 2008; or increasing time pressure, Friese, Wanke, & Plessner, 2006) has shown increased effects of implicit attitudes. Similarly, dispositional individual differences that reflect either lower ability for control or lower motivation for control have also revealed stronger effects of implicit attitudes (e.g., lower working memory, Thush et al., 2008; lower response inhibition, Houben & Wiers, 2009). Thus, as suggested by Hofmann, Friese, and Strack (2009), prediction of behavior may be more successful when considering both reflective, controlled processes (and explicit attitudes) as well as more automatic, impulsive processes (and implicit attitudes).

The need to consider both automatic and controlled processes may be particularly important in the case of smoking cessation, in which circumstances of both high and low control are likely to be relevant. Cessation attempts (particularly those in the context of intervention programs but also self-initiated attempts) are often planned in advance. They may involve a planned quit date with planned strategies to cope with anticipated temptations to smoke. Quit attempts that are planned in advance involve controlled processes, which are likely to be predictable from explicit attitudes. Indeed, a plan to quit is a form of behavioral intention, and according to the Theory of Reasoned Action and the Theory of Planned Behavior, behaviors based on such intentions should be predictable from explicit attitudes (Ajzen & Fishbein, 1970; Ajzen & Madden, 1986). Moreover, a plan to quit smoking is also likely to imply some motivation to control smoking behavior, further suggesting that controlled processes and explicit attitudes should predict behavior (Friese, Hofmann, & Schmitt, 2009). However, not all quit attempts involve an advance plan. In fact, recent studies have suggested that some quit attempts are unplanned and relatively spontaneous, and that these unplanned quit attempts may also result in cessation (Ferguson et al., in press; Larabie,

2005; West & Sohal, 2006). In the absence of pre-planning, implicit attitudes may be stronger predictors of behavior. Thus, the current study tested whether having a plan to quit moderated the ability of explicit and implicit attitudes to predict cessation. We predicted that explicit attitudes should have stronger effects on cessation among smokers with a pre-existing plan to quit than among smokers without such a plan. In contrast, implicit attitudes might have stronger effects on cessation among smokers without a pre-existing plan to quit than among smokers with a pre-existing plan.

However, even if smokers have a pre-existing plan, their nicotine dependence likely creates situations in which individuals experience repeated failures to control their smoking behavior. These experiences with failure to control smoking behavior are, in turn, likely to produce heightened perceived difficulty of quitting and lowered perceived control over smoking. Indeed, in the Theory of Planned Behavior, perceived difficulty and perceived control are the two proposed components of perceived behavioral control (Courneya, Conner, & Rhodes, 2006). Although there is some controversy in the field about whether perceived difficulty and perceived control are best viewed as unidimensional (Courneya et al., 2006) or as inter-related but distinct (Rise et al., 2008), by either account experiences with failure to control smoking should be related to lowered perceived control over smoking. Indeed, in studies of other health behaviors, self-reports of experienced difficulty performing the behaviors have been considered to be proxy measures of actual control, and have been shown to demonstrate the same effects as perceived behavioral control in empirical tests of the Theory of Planned Behavior (Sheeran et al., 2003).

Another example of the link between experienced failures to control and perceptions of lack of control can be found in the theory of learned helplessness (Seligman, 1972) in which experiences with uncontrollable stressors induce a perceived lack of ability to control outcomes with one's own behaviors. Moreover, recent social psychological research suggests that, to the extent that lack of control creates disbelief in free will either in general or more specifically with respect to an addictive behavior, then this perceived lack of control over the behavior will serve as a cue to act on impulsive, automatic processes rather than controlled processes (Baumeister, Masicampo, & DeWall, 2009; Vohs & Baumeister, 2009). Taken together, this previous research suggests that experiences with failures to control smoking behavior will be likely to reduce perceived control over smoking and that reductions in perceived control over smoking will magnify the operation of automatic processes. Based on this research, we predicted that experiences with failure to control smoking behavior would also moderate the effects of implicit attitudes on smoking cessation such that implicit attitudes would be stronger predictors for individuals who had experienced more failure to control their smoking, compared to those who had experienced less failure to control their smoking, whereas the reverse would be true for explicit attitudes.

Finally, given that both a plan to quit and experiences of failure to control smoking were hypothesized to moderate the effects of attitudes on smoking cessation, it is possible that the combination of planning and the absence of experienced failures of control would show even stronger effects than either one alone. According to Fazio and Towles-Schwen's 1999 MODE model, explicit attitudes should have their strongest effects when there is both a pre-existing plan to quit (reflecting an intention to engage controlled processes and some motivation to do so) and experienced failures of control are low (producing higher perceived ability to control the behavior). Conversely, implicit attitudes should have their strongest effects when there is no pre-existing plan (reflecting less intention to engage controlled processes and less motivation to do) and when experienced failures to control smoking are high (producing a perceived inability to control the behavior). Accordingly, we also tested the three-way interactions among a plan to quit, experienced failures to control smoking, and

implicit attitudes toward smoking as well as among a plan to quit, experienced failures to control smoking, and explicit attitudes toward smoking.

In short, the current study had two goals. First, we extended prior work by testing whether implicit measures of attitudes toward smoking would prospectively predict smoking cessation over a long time interval among a community sample of smokers. Second, we tested whether plans to quit and experienced failures to control smoking (and their interaction) would moderate the effects of explicit and implicit attitudes on later smoking cessation. We hypothesized that both explicit and implicit attitudes would prospectively predict cessation but that implicit attitudes would predict behavior more strongly in the absence of a plan and when experienced failures of control over smoking were high, whereas explicit attitudes would predict behavior more strongly when there was a pre-existing plan to quit and when experienced failures of control over smoking were low.

Method

Participants

Participants were adults who were recruited to a longitudinal web-based study that was derived from a larger longitudinal study. The larger project, the IU Smoking Survey (Chassin et al., 1984; 2008), is an ongoing longitudinal study of cigarette smoking in a community sample. Original IU Smoking Survey participants were all 6^{th}–12^{th} graders in a county school system who were present in school on the day of testing at least once for annual assessments between 1980 and 1983 (total N=8,487). Mail follow-ups were conducted in 1987, 1993, 1999, and 2005. In each case, 70% or more of the original sample were successfully retained. The sample is representative of its community, one that is predominantly white (96% non-Hispanic Caucasian) and well-educated (see Chassin et al., 2000; 2008). For each follow-up, although biases have been small in magnitude (e.g., Rose et al., 1996), dropouts were more likely to be smokers and to have more positive attitudes and beliefs about smoking, as well as to have parents and friends who were more likely to smoke.

The web-based study was designed to test the role of implicit attitudes in adult smoking cessation, adolescent smoking onset, and parents' messages to their children about smoking. To accomplish these aims, in 2005, all IU Smoking Survey participants who had adolescent children between ages 10–18, and their spouses, as well as all currently smoking IU Smoking Survey participants who were not parents, were recruited to the new web-based study. Of the 4451 total adults who were invited, 2720 (61%) completed a baseline assessment. Of those who completed the baseline assessment, 601 (22%) reported current (at least monthly) smoking and thus were eligible for the current analyses. Of these, 460 completed the 18-month follow-up (77% retention). Those who were lost to follow-up did not significantly differ from those who were retained in gender, age, plans to quit, experienced failure to control smoking, and implicit or explicit attitudes (chi squares and t-tests, all *p*s>.14). However, those who were retained smoked fewer cigarettes per day [t (df=270.724)=−2.19, p=.02] and had higher educational attainment [$\chi^2(1)=11.60$, p=.001].

Of the initial 460 smokers who completed both assessments, 449 could be categorized as either quitting smoking or continuing to smoke and were retained for analyses. Seven participants were dropped because, at follow-up, they self-categorized as "ex-smokers" but also reported recent smoking, making it ambiguous whether or not they were relapsers, and one participant was dropped for similar ambiguity at baseline. Three participants who were monthly smokers at baseline and reported at follow-up that their last cigarette was one to six months prior were dropped because their cessation status could not be confirmed. That is, if they smoked one month ago, this could reflect either cessation or continuity of their usual

low-frequency smoking rate. Of these 449, 370 (82%) were original IU Smoking Survey participants and 79 (18%) were spouses of original IU Smoking Survey participants. The sample contained 31 married couples. Demographically, 47% of these 449 smokers were male; 51% had some education past high school; 95% were non-Hispanic Caucasian; and their average age was 38 (range 30–54). In support of sample representativeness, these characteristics are similar to those of all smokers assessed at the 2005 wave of the IU Smoking Survey (52% male; 43% had some education past high school; 96% non-Hispanic Caucasian; and ages 32–44 with an average age of 38).

Procedure

Data were obtained from two 15-minute web-based sessions, 18-months apart. Participants were provided with a unique PIN number and instructions for accessing a secure web site for a study of attitudes, beliefs, and smoking behavior. Those who failed to complete the session were reminded by telephone, email, and postcards. Upon completion of each session, participants were paid $15 and entered in lottery drawings for additional cash prizes of $50 to $250.

Measures

Smoking Status and Amount Smoked—At baseline and 18-month follow-up participants self-reported their smoking status as “Never smoked, not even a single puff,” “Smoked once or twice ‘just to try’ but not in the last month,” “Do not smoke, but in the past I was a regular smoker,” “Smoke regularly, but not more than once a month,” “Smoke regularly, but not more than once a week,” “Smoke regularly, but not more than once a day,” and “Smoke more than once a day.” Those who smoked at least monthly were considered to be smokers. Because amount of smoking is a predictor of cessation, the amount of cigarettes usually smoked per day was included as a covariate in our models. This was measured with a single item with eight response options ranging from zero to more than 40 per day. Two percent of participants (n=11) reported less than one cigarette per day; 14% (n=61) reported smoking between one and four cigarettes per day; 12% (n=52) reported smoking 5–9 cigarettes per day; 15% (n=69) reported smoking 10–14 cigarettes per day; 30% (n=135) reported smoking 15–20 cigarettes per day; 19% (n=83) reported smoking 21–30 cigarettes per day; 7% (n=33) reported smoking 31–40 cigarettes per day; and 1% (n=5) reported smoking more than 40 cigarettes per day.

At the 18-month follow-up, 14% (n=64) reported themselves to be ex-smokers and reported that their last cigarette was more than one month ago. For analyses, they were categorized as quitters. Those who reported themselves as current, at least monthly smokers were categorized as continuing smokers (n=385; 86%). We chose past month nonsmoking as our criterion to best balance a duration that would indicate some stability of nonsmoking but also provide adequate sample size to model cessation as an outcome.

Plans to Quit—At baseline, participants reported their plans to quit within the next 18 months. Response options were “Yes.”, “Not sure, I’ve given it some thought but I have not made any definite plans.”, “I have not thought about quitting.”, and “No, I have given it some thought but I have no plans to quit within the next 18 months.” Participants who answered “yes” were categorized as planning to quit (31%). Those who chose any other response option were categorized as not planning to quit (69%).

Experienced failure to control smoking—Three Diagnostic and Statistical Manual Version 4 (DSM-IV) tobacco dependence symptoms were used to assess experiences of failure to control smoking behavior. These items were: “How much do you smoke even though you promise yourself you won’t?” “How much do you smoke more frequently or for

more days in a row than you intend?" and "How much do you try to stop or cut down on your smoking but are unable to do so?" Response options were on a four-point scale from "not at all" to "quite a bit" so that higher values indicate greater perceived lack of control. Internal consistency was .82. As reflected in our use of dependence symptoms, experienced failure to control smoking behavior is one dimension of tobacco dependence, although it is not identical to the broader construct of dependence, which is multidimensional (Piper et al., 2008). Consistent with this, our experienced failure to control smoking items were significantly ($p<.05$) but weakly ($r=.165$) correlated with the overall score on the Fagerstrom Test of Nicotine Dependence (Heatherton et al., 1991). Moreover, in support of the construct validity of this measure, experienced failure to control smoking was significantly related to the number of cigarettes smoked per day ($r=.23$), perceptions that in general smoking is an addictive behavior ($r=.28$), agreement with a statement that "if" the participant smoked he/she would be "hooked," ($r=.37$), and stronger endorsement of addiction motives underlying smoking behavior ($r=.33$).

Educational Attainment—Because educational attainment is a predictor of smoking cessation, we included it as a covariate. Educational attainment was dichotomized as no post-high school education (49%) versus some post-high school education (51%).

Explicit Attitudes Toward Smoking—Participants reported their global attitudes toward smoking using a semantic differential measure of smoking as "nice versus awful," "pleasant versus unpleasant," and "fun versus not fun" (Ajzen & Fishbein, 1970). This measure has been used at each wave of the IU Smoking Survey and has successfully prospectively predicted smoking transitions (Chassin et al., 1984). Responses to the three items were averaged. Higher scores reflect more positive attitudes toward smoking, and the overall mean was 2.83 (range 1 to 5).

Implicit Attitudes Toward Smoking—Participants completed an implicit measure of smoking attitudes using an IAT (Implicit Association Test, Greenwald, McGhee, & Schwartz, 1998), which was administered on-line through Project Implicit's Virtual Laboratory (see Nosek et al., 2005).

There were eight pictures that showed a scene related to smoking (three pictures of someone holding a burning cigarette, two pictures of a burning cigarette in an ashtray, one picture of someone lighting a cigarette, one picture of cigarettes lying on a table, and one picture of cigarettes and a lighter lying on a table) and eight pictures of geometric shapes (rectangle, parallelogram, triangle, pentagon, trapezoid, square, oval, and octagon). Other stimuli were eight adjectives with a positive meaning (wonderful, nice, friendly, pleasant, great, excellent, terrific, and fabulous) and eight adjectives with a negative meaning (stupid, rotten, awful, dreadful, ugly, disgusting, nasty, and horrible). All stimuli were presented in the center of a black screen. Words were presented in green letters. The words smoking, shape, good, and bad were used for labels. The smoking and shape labels were presented in white letters, and the good and bad labels in green letters. Participants responded by pressing the letter e (left) or the letter i (right) on the keyboard.

The IAT is a dual categorization task. In our procedure, participants saw the four types of stimuli: pictures related to smoking, pictures of shapes, positive words, and negative words. There were five phases to each IAT during which the labels of the stimuli assigned to the left and right keys were continuously shown on the screen. The first phase was a practice phase consisting of 20 trials. During this phase, good and bad words were presented in random order. Participants were asked to match the words to the good or bad label by pressing the appropriate key (i.e., the letter i or e, counterbalanced). In the second phase, also consisting of 20 trials, the pictures of smoking scenes and shapes were presented in

random order, and participants were asked to match the pictures to the smoking or shape label by pressing the appropriate key (i.e., the letter i or e, counterbalanced). The third phase consisted of two blocks, one of 20 trials and one of 40 trials, during which pictures and words were presented in random order, and participants pressed the appropriate key. The fourth and fifth phases were identical to the second and third, except that the response assignment for the smoking and shape pictures was reversed (e.g., the letter i instead of e), and there were 40 trials in the fourth phase as opposed to 20 in the second phase. As a result, for half of the participants, the third phase contained the SMOKING+GOOD task and the fifth phase contained the SMOKING+BAD task, whereas the reverse was true for the other half of the participants. On each trial, the stimulus was presented until the participant pressed the left or right key. If the response was correct, the next stimulus appeared. If the response was incorrect, a red X was presented on the screen until the participant corrected the response. The key phases for assessing implicit attitudes toward smoking were phases three and five. To the extent that latencies of response are faster during the phase when smoking-related pictures are paired with positive words than the phase when smoking-related pictures are paired with negative words, participants have positive attitudes toward smoking.

To create IAT scores, we calculated an IAT *D* score for each participant using the scoring algorithm proposed by Greenwald, Nosek, and Banaji (2003). Because of counterbalancing in which half of participants received the “Smoking or Good” task first, and the other half received the “Smoking or Bad” task first, we standardized the IAT *D* score within each condition. Consistent with prior research on stigmatized behaviors including smoking (Rudman et al., 2007; Swanson et al., 2001), the overall raw mean IAT score was −.412, indicating a slightly negative attitude toward smoking.

Results

Bivariate relations among study variables are presented in Table 1. As shown in the table, as expected, quitting was significantly related to higher educational attainment, a lower amount of typical smoking, and a pre-existing plan to quit. Quitting was also significantly related to more negative implicit, but not explicit, attitudes toward smoking. Having plans to quit was significantly related to higher educational attainment, a lower amount of typical smoking, more negative attitudes toward smoking (both explicit and implicit), and more experienced failure to control smoking. As in past research (Hofmann et al., 2005), implicit and explicit attitudes were significantly, but modestly intercorrelated.

Predicting cessation from covariates, implicit and explicit attitudes, experienced failure to control smoking, and plans to quit

Logistic regression models predicted cessation at 18-month follow-up (yes versus no) from baseline covariates (educational attainment and amount smoked per day) and baseline predictors: plans to quit, experienced failure to control smoking, and implicit and explicit attitudes toward smoking. In a series of preliminary models, we tested all of the two-way interactions between the baseline covariates (i.e., educational attainment and amount smoked per day) and the predictors. However, none of these interactions were significant, and they were trimmed from the models. We also tested the two-way interaction between implicit and explicit attitudes, but this interaction was not significant and was trimmed.

Data were modeled in Mplus version 5.21 (Muthen & Muthen, 2006) using MLR estimation, which generates maximum likelihood parameter estimates with standard errors and chi-square statistics that are robust to non-normality and non-independence of observations. Because in 31 cases, two participants were married to each other (i.e., n=62

non-independent participants), we used the Mplus CLUSTER command, which corrects the standard errors and chi squares for the non-independence of participants.

Main Effects Model

Our initial model included only the main effects of the baseline covariates and attitudes in predicting past month nonsmoking at follow-up. There were significant unique effects of baseline amount of smoking (*B*=−.287, *p*=.008) and baseline implicit attitudes (*B*=−.422, *p*=.012), and marginally significant unique effects of education (*B*=.533, *p*=.070) and baseline plans to quit (*B*=.519, *p*=.097). Quitters initially smoked less per day, had pre-existing plans to quit, had more negative implicit attitudes toward smoking, and were better-educated than those who were still smoking at follow-up. There were no significant unique main effects of baseline explicit attitudes or experienced failure to control smoking over and above the other predictors.

Model adding interaction terms

Next we estimated a model that predicted past month nonsmoking at follow-up from the main effects described above and added the two-way and three-way interactions among the baseline attitude variables and hypothesized moderators (plans to quit and experienced failure to control smoking). The results of this full model are presented in Table 2. The associated odds ratio for each predictor (OR, see Table 2) is a measure of effect size indicating the change in odds of quitting that is associated with a one unit change in the predictor (with an OR=1 indicating no effect). ORs of less than 2 or more than .5 are considered to be small effects.

For explicit attitudes, there was a significant two-way interaction with experienced failure to control smoking (*B*=.847, *p*=.026) but not with plans to quit (B= −.272, *p*=.621), and no three-way interaction. We used the methods of Aiken and West (1991) to probe this interaction, testing the effect of explicit attitudes on quitting at one standard deviation below the mean, at the mean, and at one standard deviation above the mean of experienced failure to control smoking. We used MLR estimation and included the clustering variable to correct for the non-independence of participants. Results are displayed in Figure 1. Explicit attitudes significantly predicted quitting at low levels of experienced failure to control smoking (*B*= −0.750, *p*=.004, OR=.472), but not at medium levels (*B*= −0.230, *p*=.281, OR=.795) or at high levels (*B*= 0.291, *p*=.425, OR=1.338). At low levels of experienced failure to control smoking, those with more negative explicit attitudes toward smoking were more likely to quit.

For implicit attitudes, there was a significant three-way interaction among implicit attitudes, plans to quit, and experienced failure to control smoking (*B*= −0.947, *p*=.024). To probe this significant interaction, we again used the methods of Aiken and West (1991). We tested the effect of implicit attitudes on quitting at one standard deviation below the mean, at the mean, and at one standard deviation above the mean of experienced failures to control smoking. We did this separately for participants who had plans to quit and for participants who did not have plans to quit. Results of these models are shown in Figure 2. As hypothesized, among those with a plan to quit, the effects of implicit attitudes were significant at high levels of experienced failure to control smoking (*B*= −1.198, *p*=.004, OR= .302, see Figure 2), but not at medium levels of experienced failure to control smoking (*B*= −0.429, p=.143, OR=.651) or low levels of experienced failure to control smoking (*B*= 0.343, *p*=.405, OR=1.409). Among those with a plan to quit, at high levels of experienced failure to control smoking, those with more negative implicit attitudes toward smoking were more likely to quit.

Among those without a plan to quit, implicit attitudes marginally predicted quitting at low levels of experienced failure to control smoking (B= −0.407, p=.099, OR=.666), but not at medium levels (B= −0.318, p=.196, OR=.728) or at high levels (B= −0.231, p=.564, OR=.794).

Discussion

The first finding of note was that having a pre-existing plan to quit was significantly associated with a greater likelihood of smoking cessation 18 months later. This finding is consistent with the Theory of Reasoned Action (Ajzen & Fishbein, 1977) and the Theory of Planned Behavior (Ajzen, 1985), in that a plan is a form of behavioral intention, which is hypothesized to be a proximal predictor of actual behavior. Also consistent with these theoretical models, attitudes (both explicit and implicit) were significant correlates of these plans or behavioral intentions. Perhaps individuals who had a pre-existing plan to quit were more likely to quit because they were able to plan strategies in advance for coping with withdrawal and temptations to smoke (Gollwitzer & Schaal, 1998). However, although those with pre-existing plans were more likely to quit (20%), there was also smoking cessation (12%) among those who, at baseline, had no plan to quit. Given the long time interval between baseline and follow-up assessments, these smokers may have made a plan to quit at some later point in the interval. Alternatively, as reported in recent studies (Ferguson et al., 2009; West & Sohal, 2006), their quit attempt may have been unplanned and more spontaneous and less consistently influenced by controlled processes.

The central focus of our study was on the role of implicit and explicit attitudes in predicting smoking cessation. Implicit and explicit attitudes were significantly, albeit modestly, intercorrelated. This is consistent with previous research that supports the structure of implicit and explicit attitudes as two correlated, but distinct, constructs that tap different aspects of attitudes (Hofmann et al., 2005). Moreover, our bivariate correlations and main effects model showed significant effects of implicit but not explicit attitudes on smoking cessation. As in past research, overall in our sample, smokers had negative implicit attitudes toward smoking (Rudman et al., 2007; Swanson et al., 2001). Nevertheless, our findings suggest that those with relatively more negative implicit attitudes were more likely to have quit smoking 18 months later. This is the first study to demonstrate that implicit attitudes predict smoking cessation among a community sample of smokers and after such a long time interval, suggesting that the effects of implicit attitudes extend to naturally-occurring processes of smoking cessation. The significant effects of implicit attitudes suggest that interventions to change implicit attitudes may be useful components of intervention strategies. As noted by Stacy and Wiers (2006), these interventions might include creating new associations in memory, re-training attention, and/or using practice to get controlled processes to be more automatized.

If our models had been restricted to only the main effects of attitudes in predicting cessation, we might have concluded that only implicit attitudes are important for the processes of smoking cessation, and that research methods and interventions that focus on explicit measures of attitudes are of limited value, perhaps because social desirability concerns weakened their validity. However, this conclusion would be misleading because, when interactions with plans to quit and with perceived lack of control over smoking were considered, both implicit and explicit attitudes proved useful in the prediction of smoking cessation, but under different conditions.

As predicted by dual-process theoretical models, when experienced failure to control smoking was low (regardless of plans to quit), then more reflective, self-controlled processes and explicit attitudes were significant predictors of behavior. The notion that

explicit attitudes are better predictors of behavior when control over behavior is high is also consistent with the Theory of Planned Behavior (Ajzen & Madden, 1986). Similarly, consistent with dual-process theoretical models, with results of laboratory-based experimental manipulations (Friese, Hofmann, & Schmitt, 2009; Hofmann, Friese, & Strack, 2009), and with social psychological research on more generalized perceptions of lack of free will (Baumeister et al., 2009; Vohs &Baumeister, 2009), when experienced failure to control smoking is elevated, impulsive processes and automatic associations (as indexed by implicit attitudes) are significant predictors of behavior. Thus, we observed significant prediction by implicit attitudes when individuals had high experienced failure to control smoking (albeit only among those who had plans to quit).

Exceptions to the predicted pattern for implicit attitudes occurred among those without plans to quit. In the absence of a plan, implicit attitudes predicted cessation when experienced failure to control smoking was low rather than high (albeit with only marginal significance). It is difficult to interpret this anomaly because of the unknown circumstances that might lead these smokers to quit when they had no plans to do so. As noted earlier, perhaps the absence of a plan itself reflects the operation of more automatic, spontaneous processes. Consistent with Fazio and Towles-Schwen's (1999) MODE model, if the absence of a plan reflects low intentions and/or motivation to engage controlled processes, then more automatic processes will be strengthened. However, in general, little is known about smoking cessation in the absence of a plan to quit (Ferguson et al., in press; Larabie, 2005; West & Sohal, 2006) and further research is required to understand these circumstances.

The current study provides important support for dual-process approaches when applied to the cessation of an addictive behavior. To our knowledge, our findings also provide the only true prospective, longitudinal test of these interactions under real-world conditions. Most previous reports of interactions between conditions of high and low control and implicit (or explicit) attitudes have been cross-sectional laboratory studies (see Friese et al., 2009, for a review and Grenard et al., 2008, for a substance use example). Thush et al. (2008) reported a similar interaction between implicit attitudes and working memory capacity in predicting adolescent alcohol use after a one-month interval. However, because there was only a one-month interval between the assessment of attitudes and alcohol use, there was so little change in drinking that Thush et al. (2008) could not examine change in alcohol use above and beyond baseline drinking, and thus could not draw strong inferences about temporal precedence. Our findings strengthen the inferences that can be drawn about temporal precedence because of our true prospective design (i.e., predicting cessation among initial smokers and also considering their baseline levels of smoking). Thus, our findings both replicate and extend the empirical support for the prediction that implicit attitudes are stronger predictors of substance use behavior under conditions when conscious, reflective processes are lowered (i.e., high experienced failure to control smoking, albeit in the presence of a plan to quit) whereas explicit attitudes are stronger predictors of substance use behavior under conditions of low experienced failure to control smoking.

In addition to their theoretical implications, our findings also have implications for smoking cessation interventions. First, if interventions wish to target attitude change techniques, then they need to recognize that implicit and explicit attitude change require different methods (e.g., Rydell & McConnell, 2006). Second, interventions need to recognize that any smoking cessation attempt is likely to involve both controlled and automatic processes. The current study considered two between-subjects factors (plans to quit and experienced failure to control smoking), which suggest that interventions may need to be differentially tailored to these subgroups. Smoking cessation interventions are typically delivered to smokers who are planning to quit. For those smokers, our findings suggest that interventions to change implicit attitudes should be more important for those with high experienced failure to control

smoking whereas interventions to change explicit attitudes should be more important for those with low experienced failure to control smoking.

However, for any single individual, despite their plans to quit, experienced failure to control smoking, and level of dispositional ability to control behavior (e.g., impulsiveness, working memory, response inhibition), the processes involved in stopping an addictive behavior such as cigarette smoking are likely to involve both reflective and automatic processes. Thus, targeting only implicit or explicit attitude change is unlikely to be sufficient even for those with particularly high or particularly low dispositional abilities for behavioral control. The limitations of targeting only automatic associations may be seen in the limited success of treatments like cue exposure or attentional retraining, whose effects are context-dependent (Brandon et al., 2007; Field et al., 2009). Interventions to influence controlled processes, such as mindfulness, which attempts to prevent the “hi-jacking” of controlled processes by automatic associations, may be beneficial additions to attempts to change automatic associations (Brandon et al., 2007).

Although the current study contributes to the literature by being the first to demonstrate that implicit and explicit attitudes differentially predict smoking cessation in a community sample after 18-months as a function of high and low experienced failure to control smoking and plans to quit smoking, there are also limitations that should be considered. First, given the long time interval between assessment of the predictors and the outcome, participants may have changed their plans and attitudes during the interval. However, given the similarity of the current findings to those from previous cross-sectional studies this problem is unlikely to affect interpretation of the current interactions. Second, our definition of smoking cessation required abstinence for only one month, so future relapse could still occur (Wetter et al., 2004). An even larger sample size would be necessary to generate sufficient cases of quitting to test more stringent definitions of cessation. Third, our measurement of explicit attitudes was not comprehensive, and our measurement of experienced failure to control smoking is not identical to typical perceived behavioral control measures used in tests of the Theory of Planned Behavior. Finally, although our sample was representative of its community, the community is predominantly non-Hispanic Caucasian and well-educated, and findings may not generalize to different demographic groups.

In short, the current study demonstrated that both implicit and explicit attitudes were important in the prediction of smoking cessation in a community sample. However, implicit and explicit attitudes were differentially important depending on participants’ experienced failure to control smoking and plans to quit. When experienced failure to control smoking was high and there were plans to quit, implicit (but not explicit) attitudes significantly predicted cessation. However, when experienced failure to control smoking was low, explicit attitudes significantly predicted cessation (regardless of plans to quit), and implicit attitudes were marginally significant only in the absence of a plan. These results are consistent with dual-process models of behavior and have implications for constructing smoking cessation interventions that target both automatic and controlled processes.

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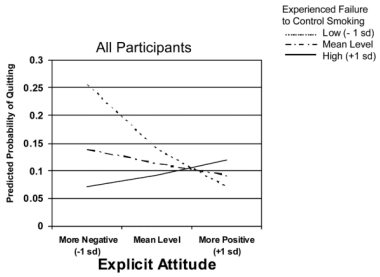

Figure 1.
Probability of quitting at follow-up predicted by explicit attitudes toward smoking across levels of experienced failure to control smoking.

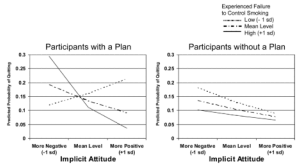

Figure 2.

Probability of quitting at follow-up predicted by implicit attitudes toward smoking across levels of experienced failure to control smoking for participants with and without a pre-existing plan to quit.

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Table 1

Bivariate relations among study variables

	Quitting outcome (past month nonsmoking)	Amount smoked	Plans to quit	Experienced failure to control smoking	Post-high school education	Explicit attitude toward smoking	Implicit attitude toward smoking
Quitting outcome (0=smoked; 1=quit)	1.00						
Amount smoked	−.222***	1.00					
Plans to quit (0=no; 1=yes)	.100*	−.117*	1.00				
Experienced failure to control smoking	−.056	.235***	.249***	1.00			
Post-high school education (0=no; 1=yes)	.144**	−.198***	.161**	−.024	1.00		
Explicit attitude toward smoking	−.046	.007	−.204***	−.239***	−.028	1.00	
Implicit attitude toward smoking	−.173***	.141**	−.110*	−.049	−.075	.153**	1.00

Note: Phi coefficients for relations between two dichotomies; point-biserial correlations for relations between a dichotomous and a continuous variable; Pearson correlations for relations between two continuous variables.

* $p<.05$;

** $p<.01$;

*** $p<.001$

Table 2

Final logistic regression model predicting quitting (Quitting =1, Not Quitting = 0) from covariates, attitudes, plans to quit, experienced failure to control smoking and interactions among attitudes, plans, and experienced failure to control smoking.

	Unstandardized Beta (*B*) (SE)	*B*/SE	Adjusted odds ratio (95% CI)*	p-value
Education	0.559 (.298)	1.875	1.749 (0.975, 3.136)	.061
Amount smoked	−0.315 (.111)	−2.831	0.730 (0.587, 0.908)	.005
Implicit attitude	−0.328 (.180)	−1.815	0.721 (0.506, 1.026)	.069
Explicit attitude	−0.317 (.295)	−1.074	0.728 (0.408, 1.299)	.283
Plans to quit	0.364 (.371)	0.981	1.439 (0.696, 2.977)	.326
Experienced failure to control smoking	−0.277 (.253)	−1.092	0.758 (0.462, 1.246)	.275
Implicit attitude by experienced failure to control smoking	−0.202 (.197)	−1.024	0.817 (0.555, 1.203)	.306
Explicit attitude by experienced failure to control smoking	0.847 (.380)	2.231	2.323 (1.108, 4.911)	.026
Implicit attitude by plans to quit	−0.109 (.358)	−0.305	0.897 (0.444, 1.809)	.761
Explicit attitude by plans to quit	−0.272 (.551)	−0.494	0.762 (0.259, 2.243)	.621
Plans to quit by Experienced failure to control smoking	0.053 (.405)	0.131	1.055 (0.476, 2.334)	.896
Implicit attitude by plans to quit by experienced failure to control smoking	−0.947 (.419)	−2.258	0.388 (0.171, 0.882)	.024
Explicit attitude by plans to quit by experienced failure to control smoking	0.491 (.661)	0.742	1.634 (0.447, 5.974)	.458

Note: High values are more positive toward smoking for explicit and implicit attitudes.

*Adjusted for all the variables in the model.